



Using KU Band PLL LNBS

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The Purposes of the Talk

- Describe 10GHz LNB receiving set ups.
- Describe a 10GHz front end for low frequency spectrum analyzers.
- Describe 24 and 47GHz front ends.

What Can You Do?

- W6SZ was able to copy DL0SHF off of the moon.
- Listen to local stations and beacons.
- Extend the range of lower frequency spectrum analyzers.



LNB's Inside and Out

- Get a *universal LNB with a PLL*.
 - They cover 10.368GHz with an IF of 618MHz -easiest LNB to use.
 - Need- 12v@200ma, bias Tee, LNB and receiver.
-

Amiko L-104 PLL

-Universal type with IF of 618MHz. \$15 and very little loss of sensitivity at 618MHz.

-

Easy to modify



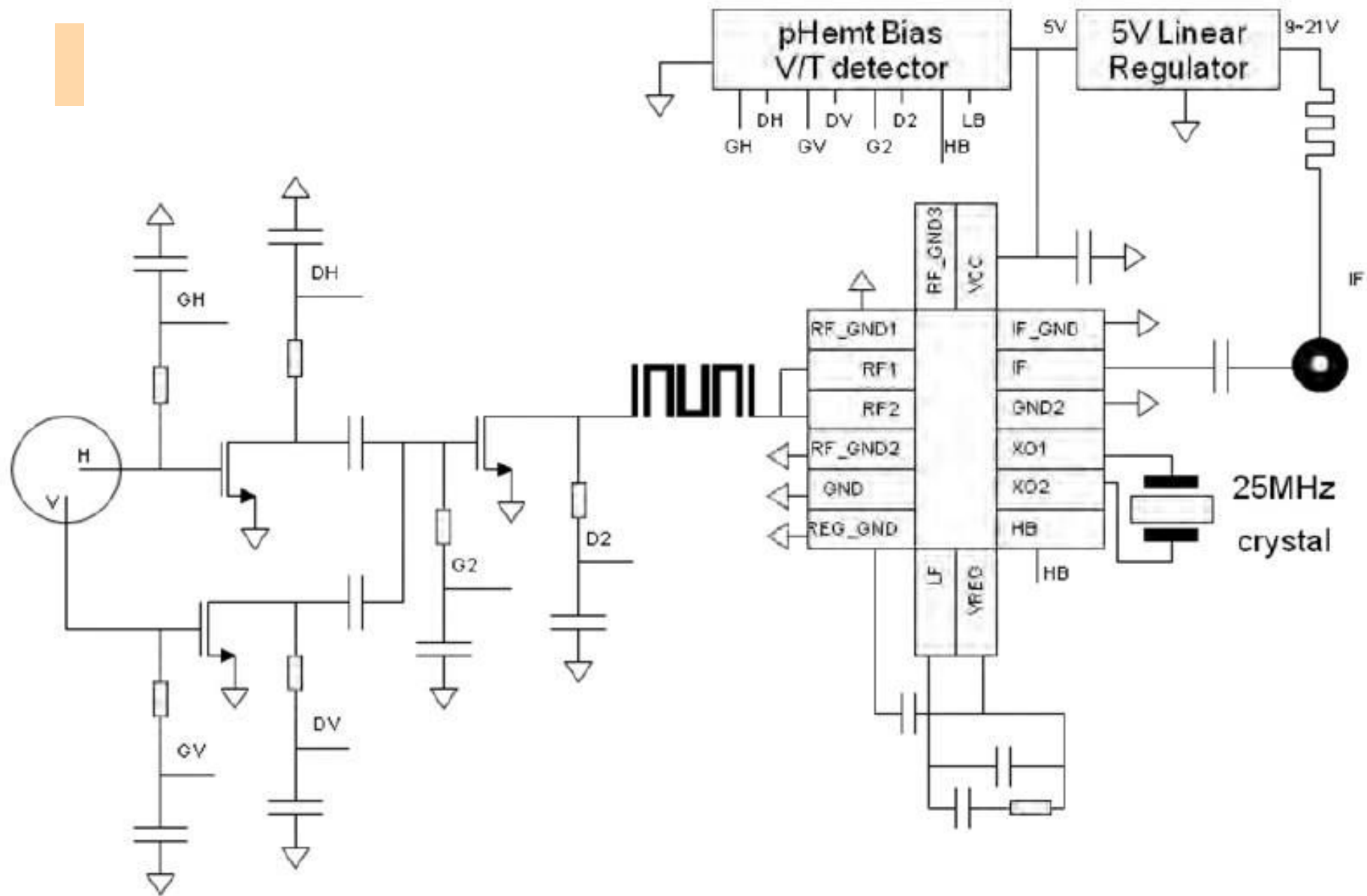
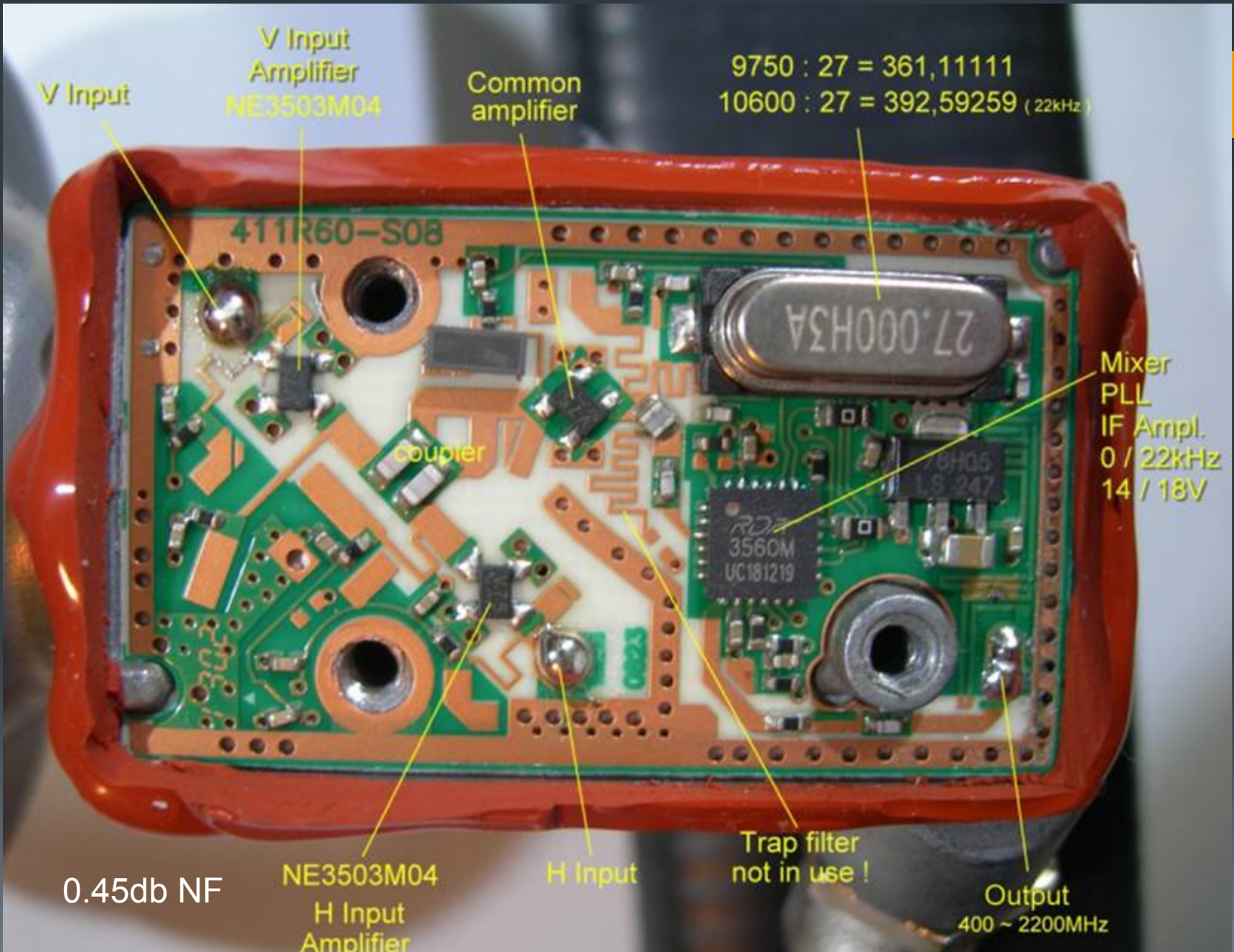


Fig 1. Typical US LNB diagram using the FIMOD IC (TFF101x)



V Input
Amplifier
NE3503M04

Common
amplifier

$9750 : 27 = 361,1111$
 $10600 : 27 = 392,59259$ (22kHz)

Mixer
PLL
IF Ampl.
0 / 22kHz
14 / 18V

Trap filter
not in use !

Output
400 ~ 2200MHz

H Input

NE3503M04
H Input
Amplifier

coupler

0.45db NF

no band-pass filter or IF filter inside , verry broadband design.

TCXO Modification

As is, the LNB's drift about 500Hz/min. after 15min warm up and poor frequency reset.

With a TCXO modification drift is 50Hz/min after 5min. Warm up. Frequency reset ability is excellent.

The crystal can be replaced by an Inexpensive TCXO

The little one is
cheaper and better!



\$10 and 0.1ppm

SDR Kits GPS Reference- more stability and any IF frequency

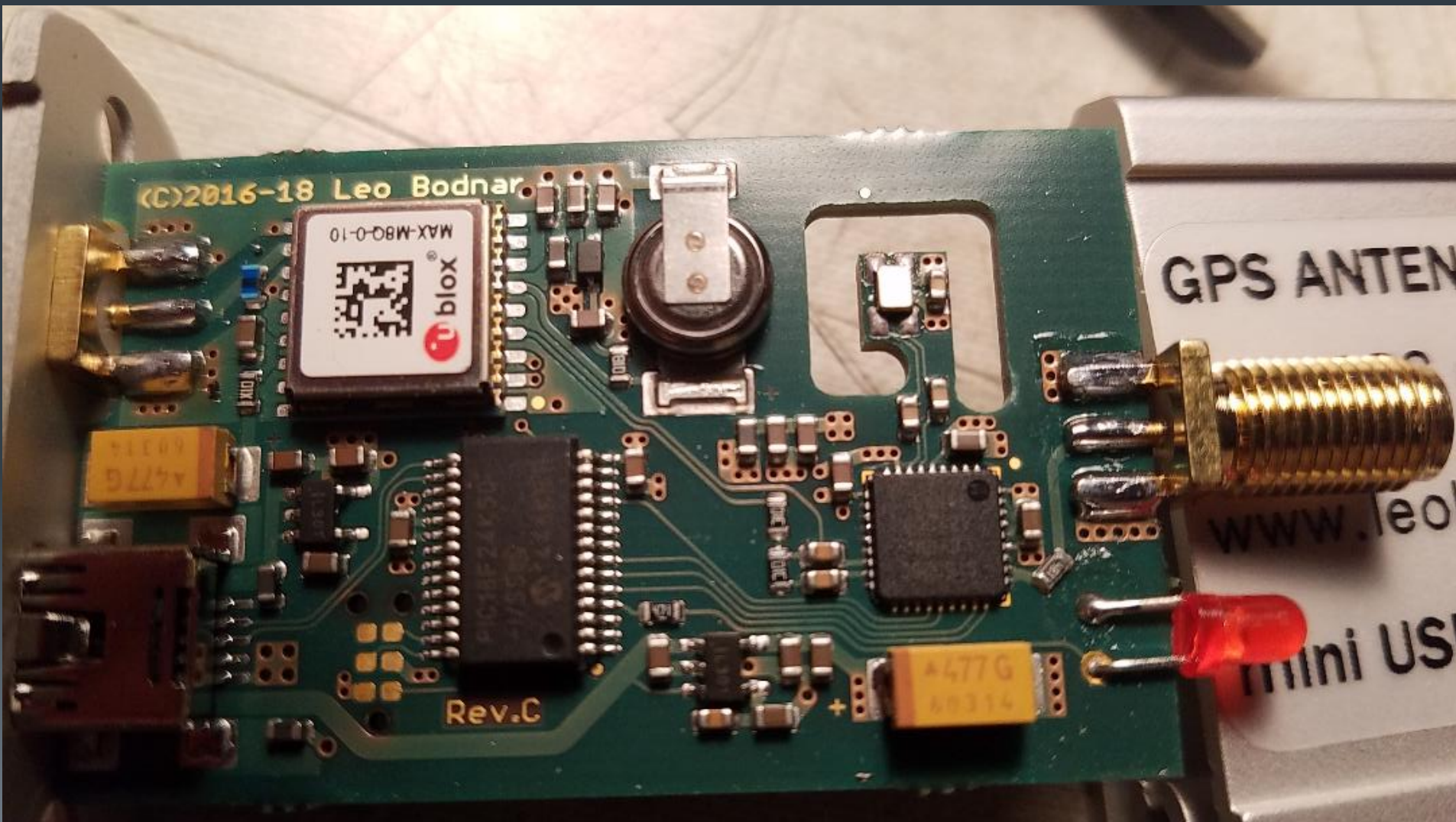


\$100

GPS Source

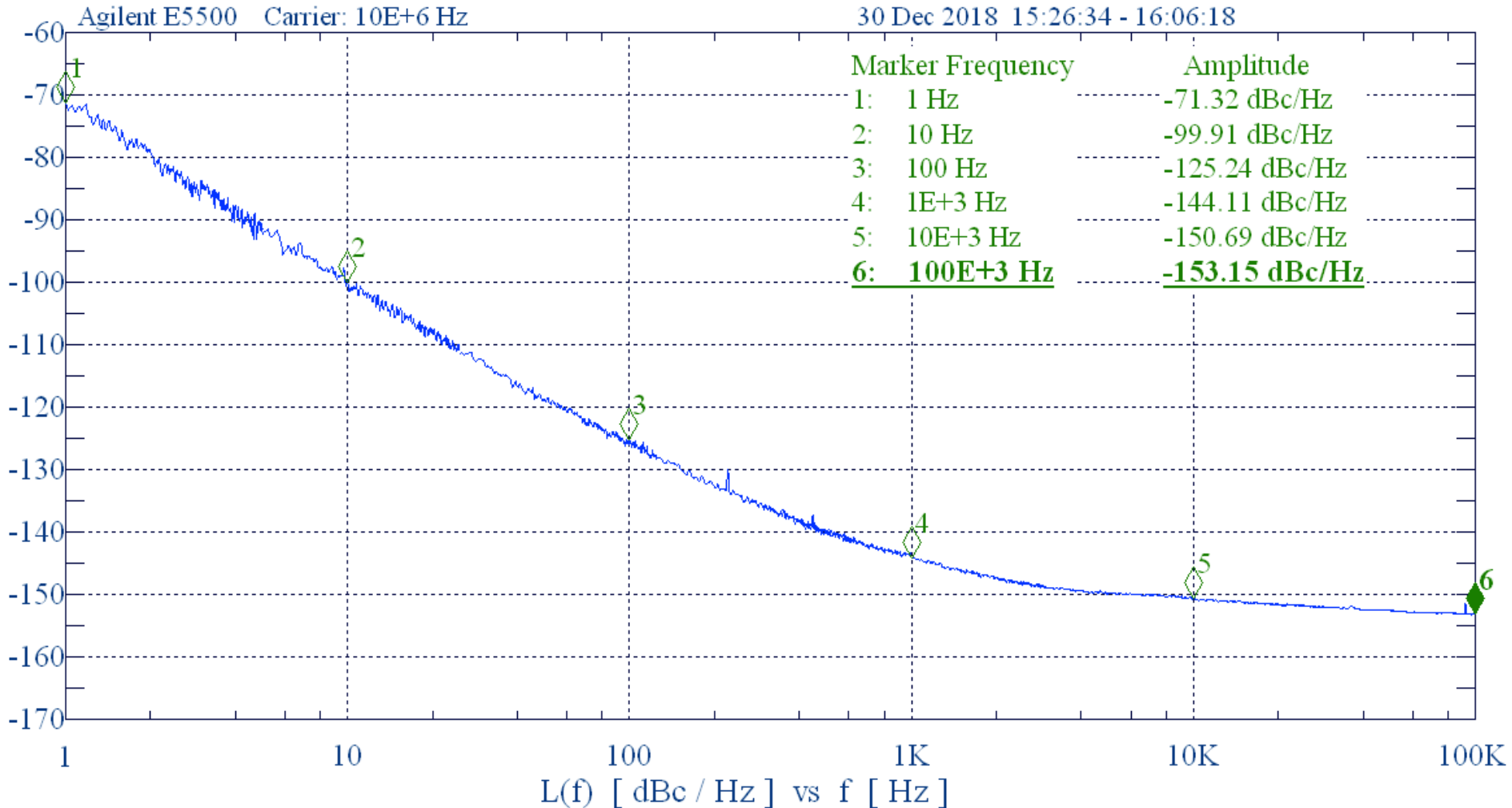
- PPB accuracy
- Has hold over- power on/off/on
- Once set, runs off of a phone charger and doesn't need the antenna.
- A frequency of 27.515MHz yields an IF of 432MHz. (factor 361.11)
- -144db Phase noise at 1KHz

Inside the GPS Source



Phase Noise

Leo Bodnar Electronics mini GPS clock phase noise at 10MHz



L104 PLL Insides Before Modification

27MHz Crystal 618.2MHz IF

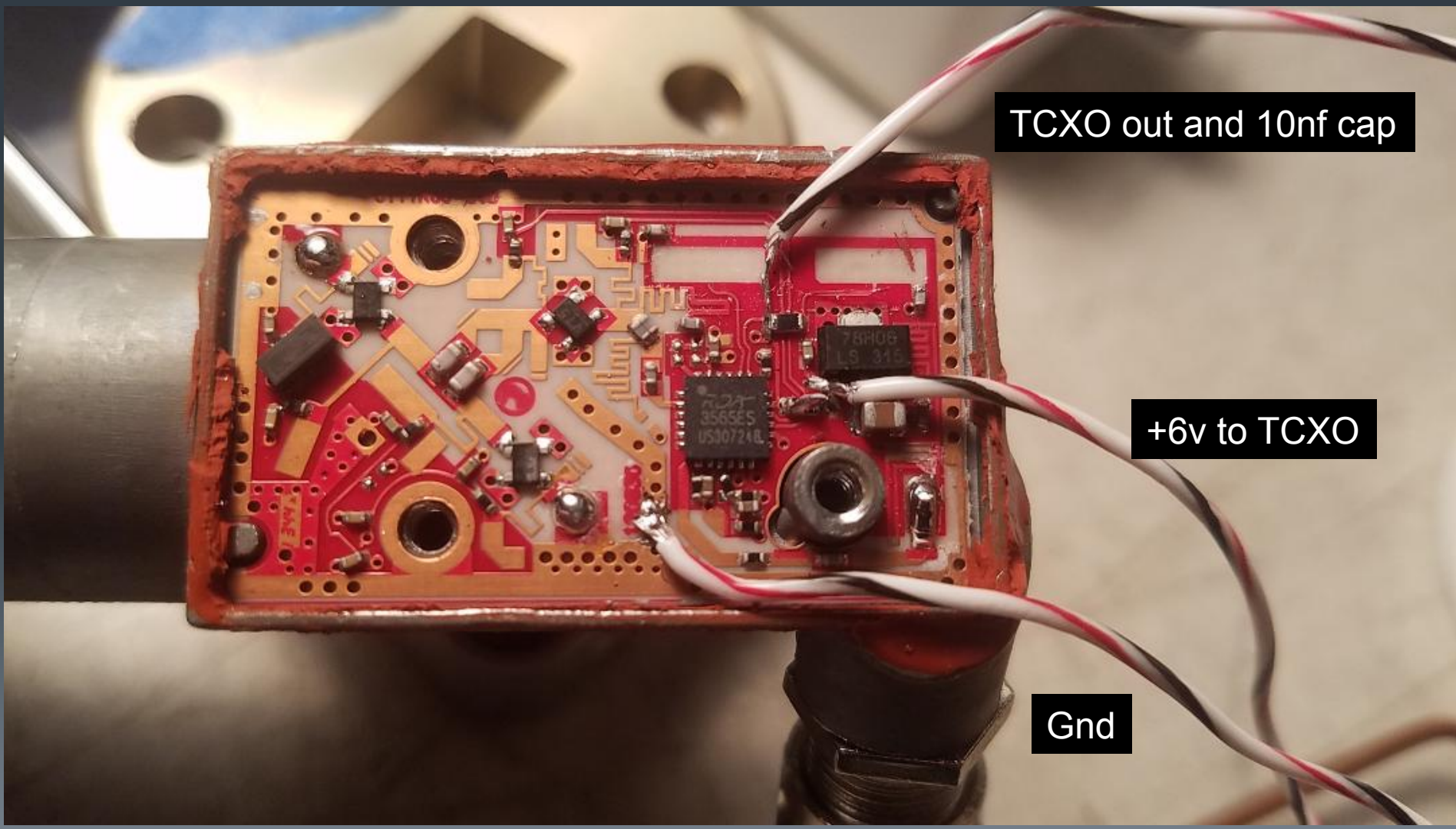
Vert In



Before modification

Horiz In

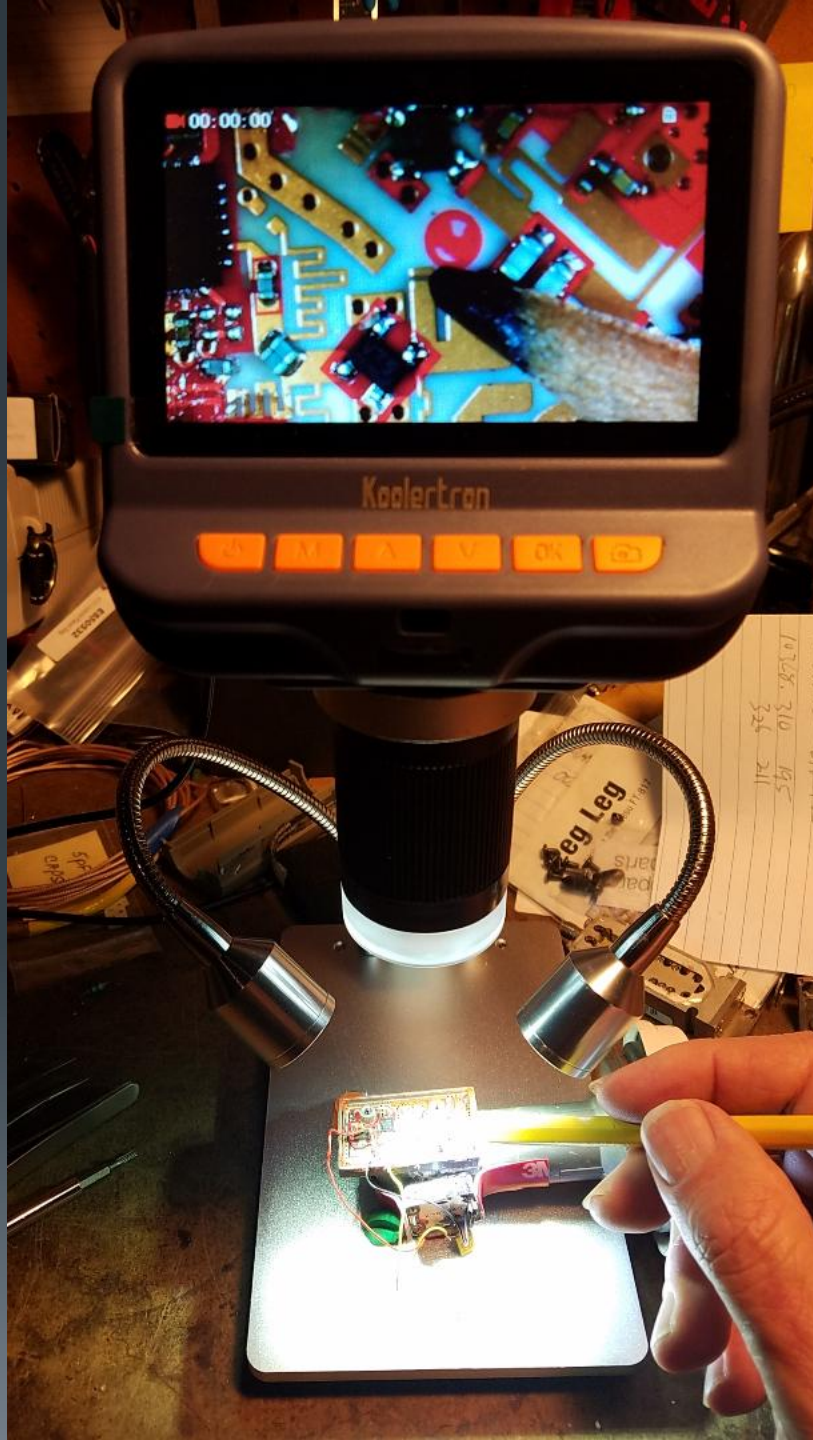
L104 After Modification with 27MHz TCXO



TCXO out and 10nf cap

+6v to TCXO

Gnd



Just sayin' -
This kept me from making a mess
Of things.

Test Results- one minute after 5 minutes = 50Hz or 10^{-10} accuracy



IF's for existing ham transceivers.

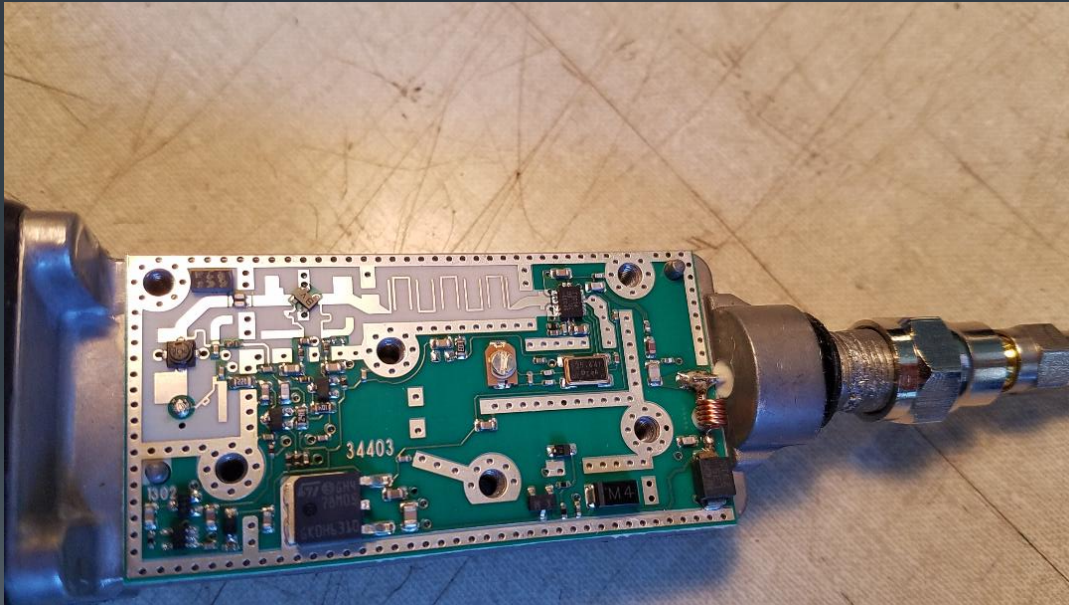
- Using a 27.515MHz crystal or the GPS source, the IF output is 432MHz.
The factor is 361.11- xtal to LO frequency.
- Two meters IF is too low
- 23cm is too high.



Other types of LNBS

1320 PLL LNB

- Has PLL but the crystal is unregulated and at 25.641MHz
- Hairpin filter gives -25db sensitivity loss at 10.368MHz
- WR75 input
- About \$20



Works with RF Explorer Analyzer

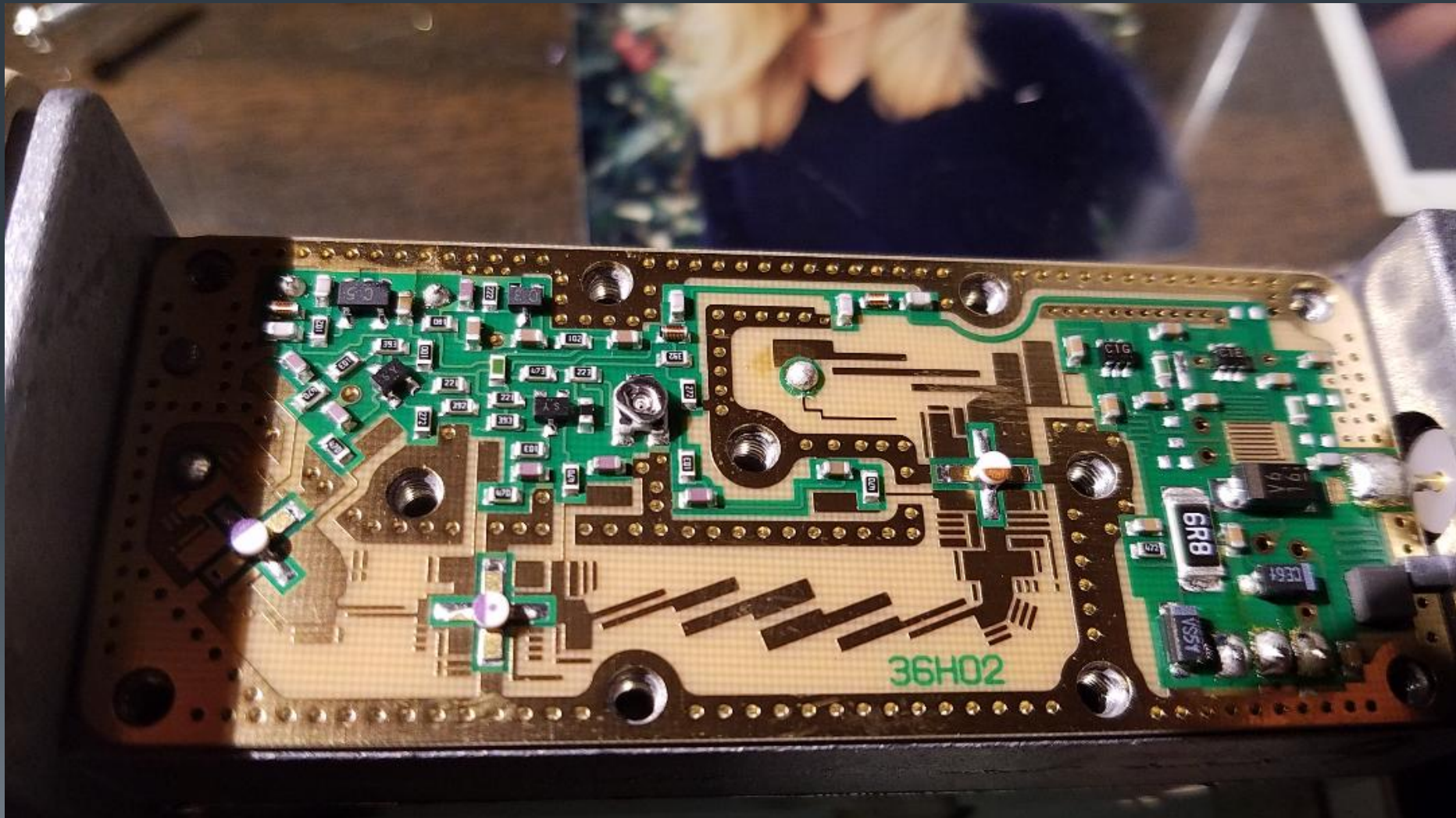


Norsat HS1057CN

- Very expensive when new-\$250,
- HS1057C translates to-
 - 5= 5kc drift (and right on freq.)
 - 7= .7db NF
 - C= 10.95GHz band
- Drift and reset of freq. are excellent
- WR 75 connector
- -10db at 10.368GHz
- IF of 368MHz



Norsat Inside RF part



Whole Package

TCXO, bias tee, 432Mhz output
Excellent stability and freq. reset

From Jan Ok2zaw

\$55



RemoteQTH.com | 10 GHz LNB WITH TCXO + DC BIAS TEE WITH ATT

<http://ok2zaw.blogspot.com/search/label/10GHz>

LNB Testing

- Most were pretty close with the Norsat at the top.
- **Norsat**- no drift discernable.
- **Stock L 104 and 1320**- 500cy/minute after 15minutes. Poor resetability.
- **Modified L104 and OK2ZAW**- 50cy/min after 5 minutes. Ten times better than stock. Excellent reset.

External Coax Input L104



Horiz is off on low range

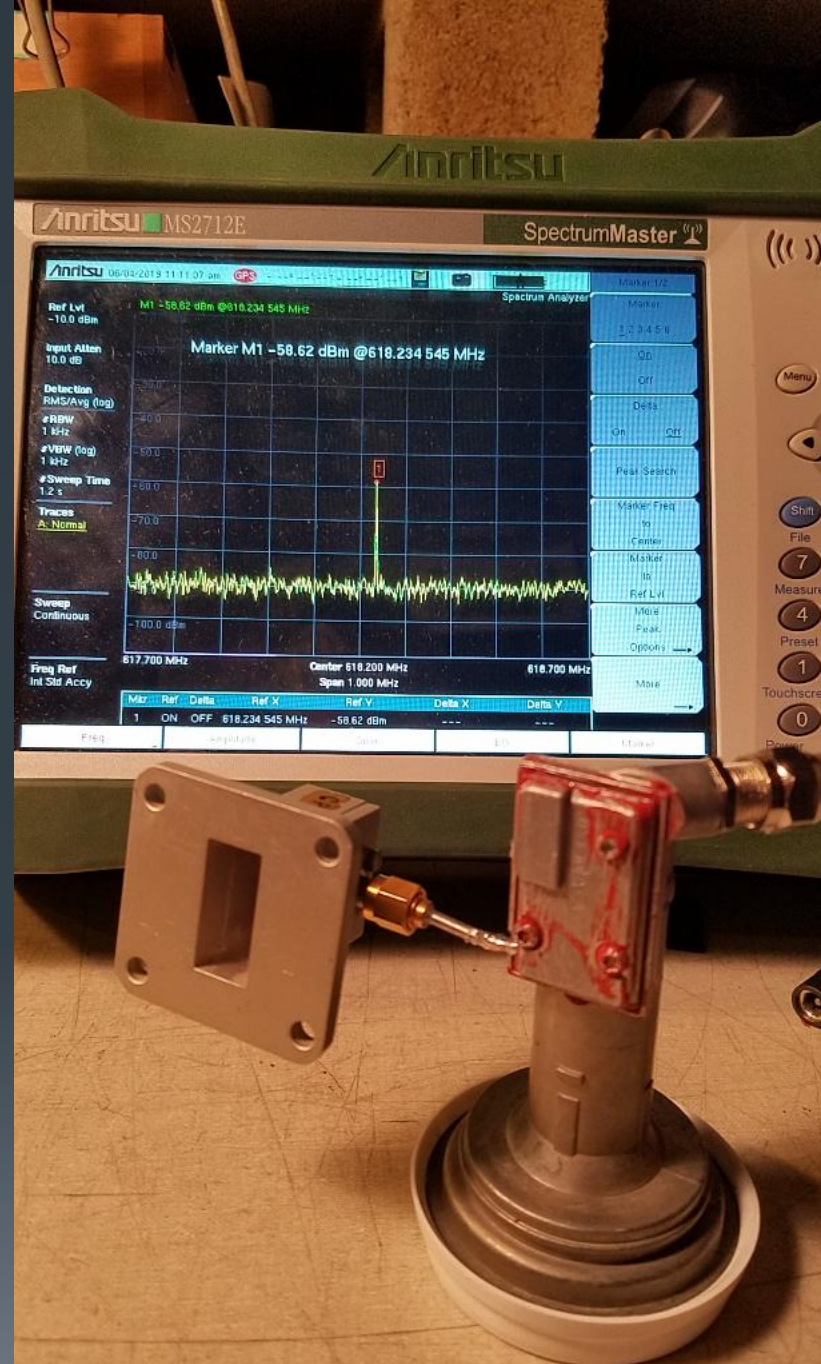


External Input Instructions

- Use the vertical input as the horiz. input is disabled by default
- Push through Vertical probe element
- File a hole in the seam of the case to pass the coax.
- Connect small dia. semi-rigid coax to V side
- For external connection
 - Use coupling cap from the gate to the coax
 - Use an external DC block. (0.6 db loss)
 - Use an SMA to WR90 adapter.

Adding a waveguide Input to the LNB

(The input has no internal
1pf Coupling capacitor.)



SMA input
With DC block
And antenna



Block= 0.6db loss

Applications

- Band Monitoring-
 1. 10GHz with a back end receiver.
 2. Stand alone receiver
 3. Spectrum Analyzer .
- **Here are some suggestions for back ends.**

Back End Receiver

Alinco DJ-X11

- A wideband receiver set to 618MHz yields good results on CW/SSB
- The receiver is far more stable than the LNB
- Sensitivity is excellent
- About **\$275** new
- Compact and battery operated



In the Field



\$25

Use A Dongle SDR



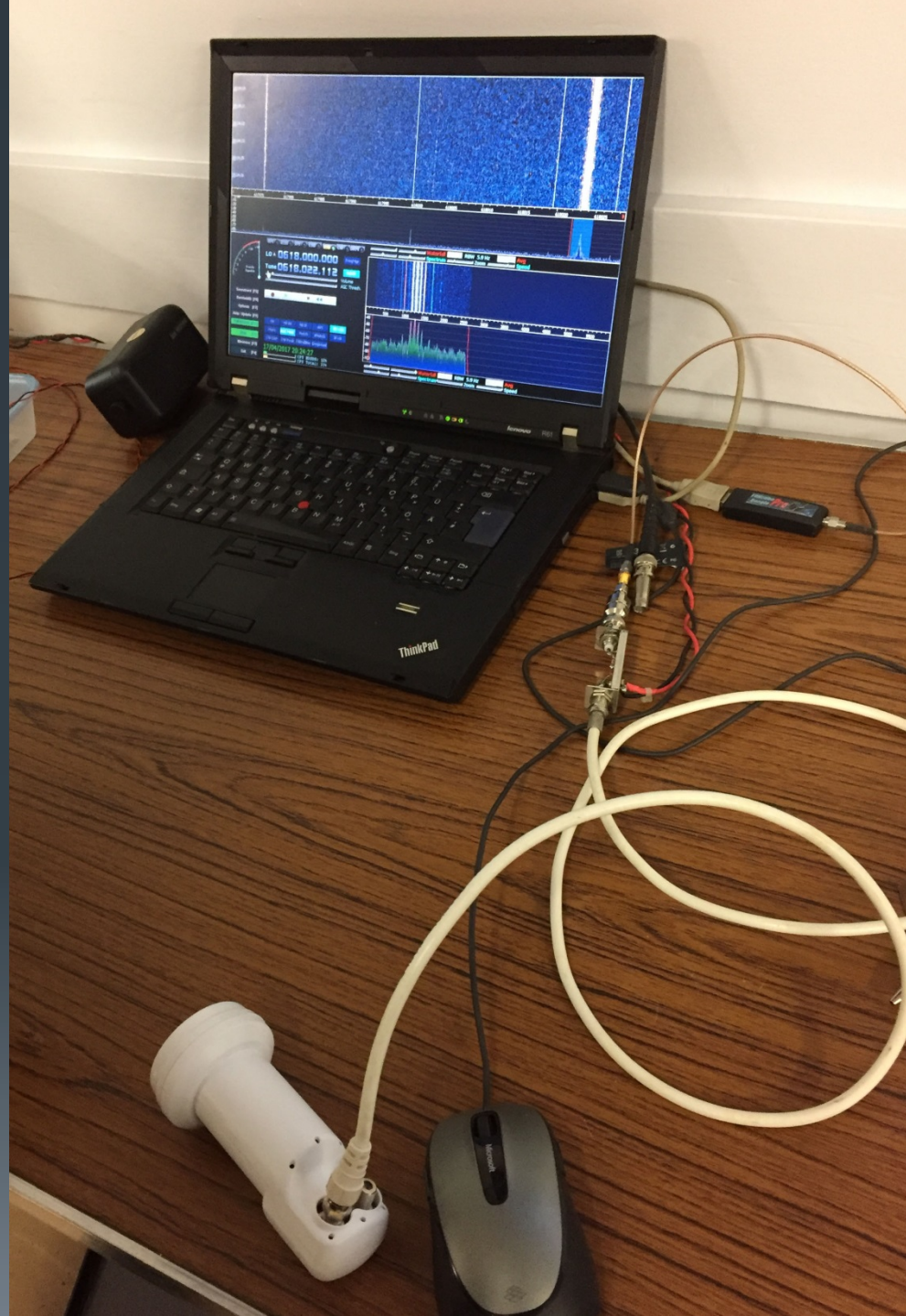
SDR-Kits



Authorised Distributor of SDRplay Products

RSP 2 \$195

From
Graham
G8HAJ

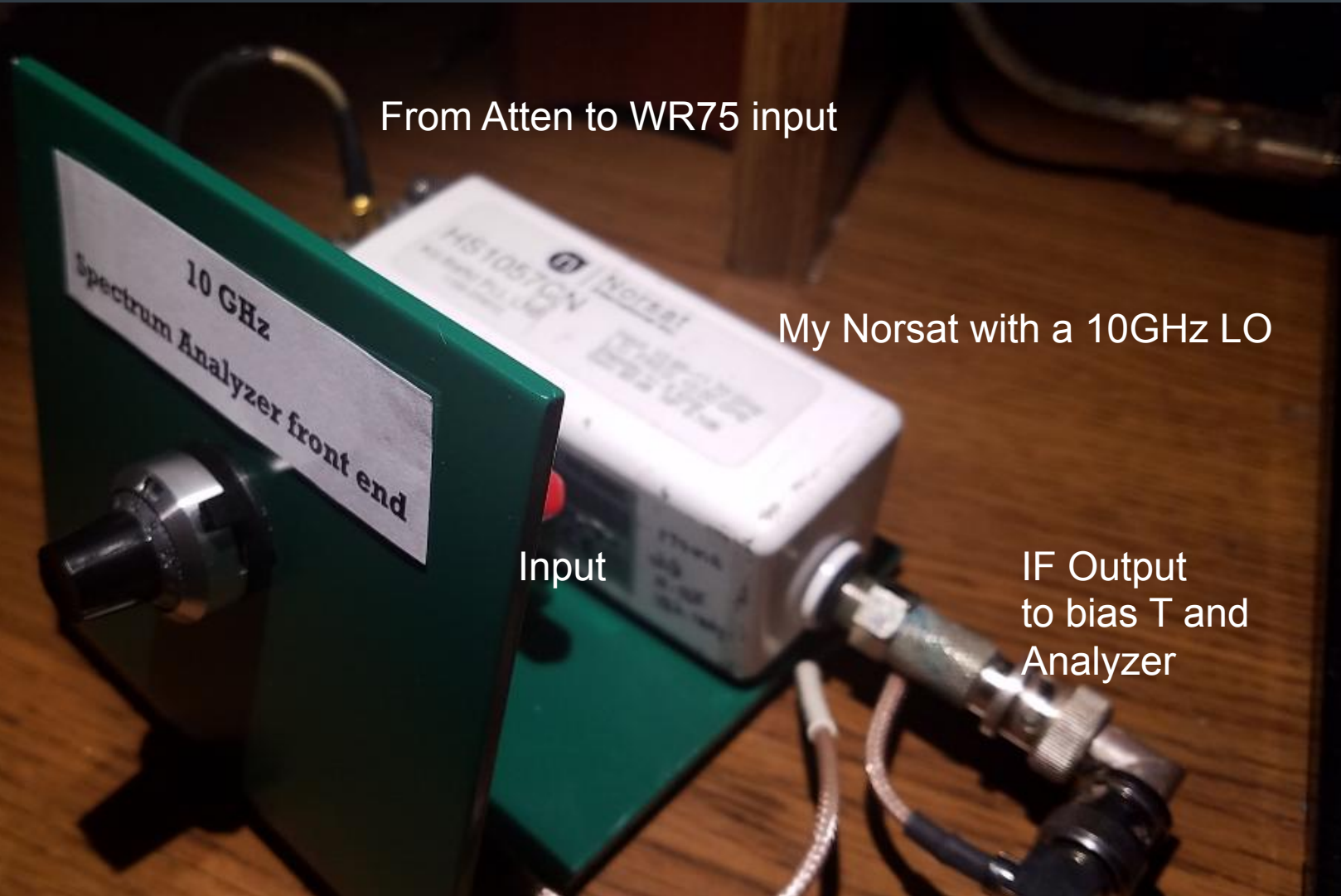


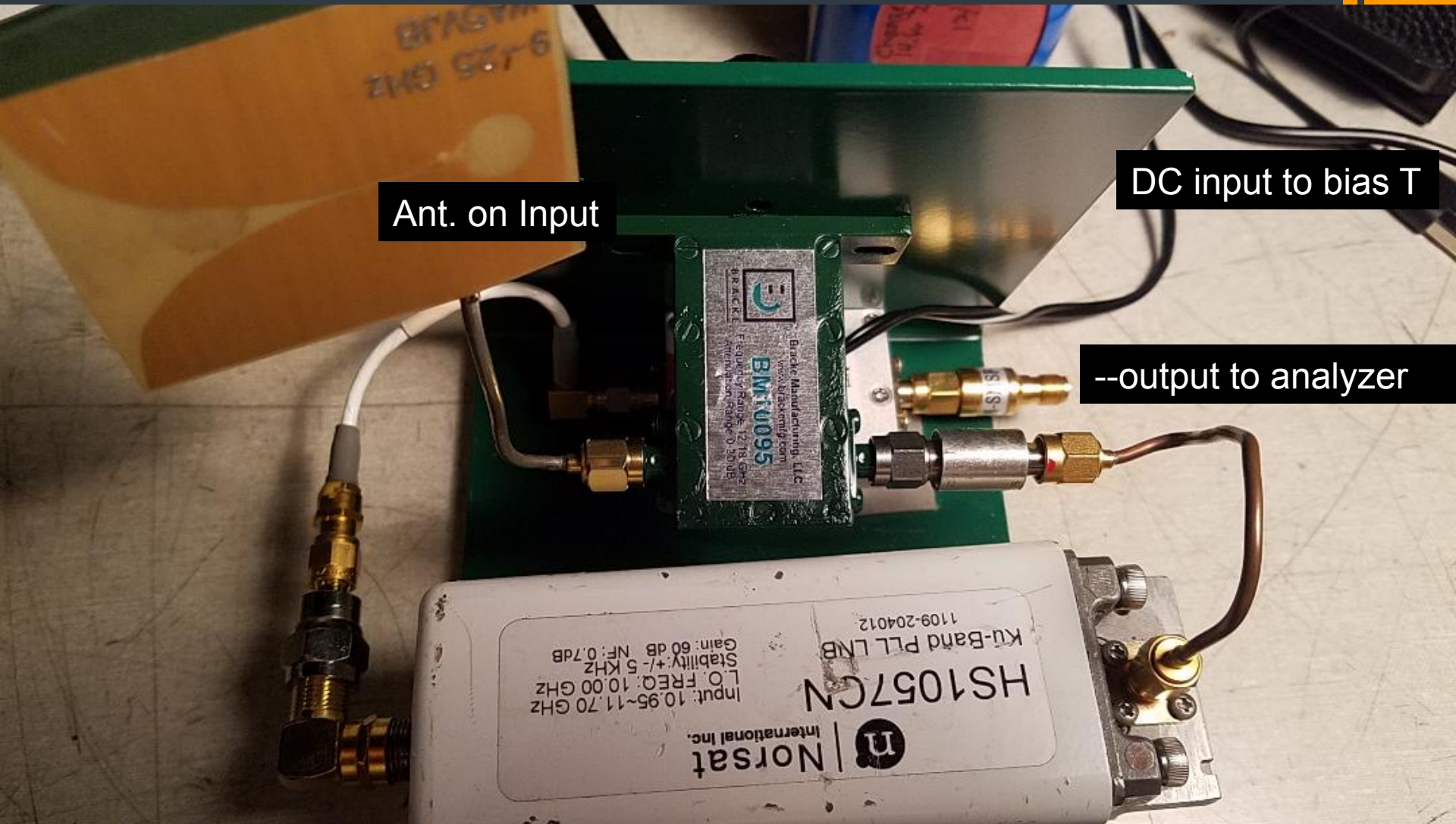
Set up with
LNB,
SDR Dongle
Bias tee
And laptop.

Spectrum Analyzer front End Designs for 10 and 24GHz

Add 10 and 24GHz ranges
to lower frequency analyzers.
Use advanced analyzer functions
at a fraction of the price of a newer
High frequency analyzer.

Norsat LNB Spectrum Analyzer Front End With attenuator 10.368GHz in 368MHz out





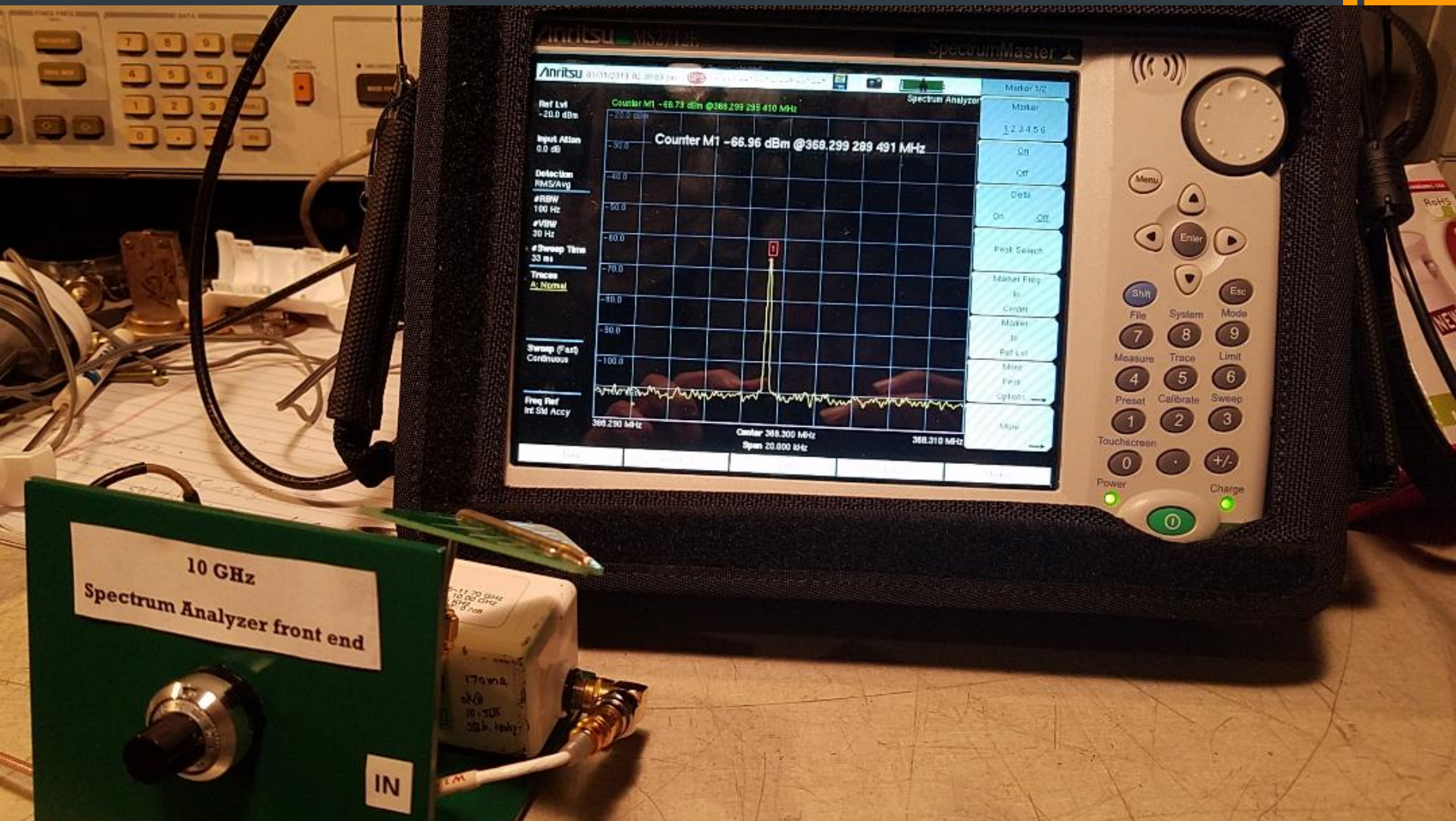
Ant. on Input

DC input to bias T

--output to analyzer

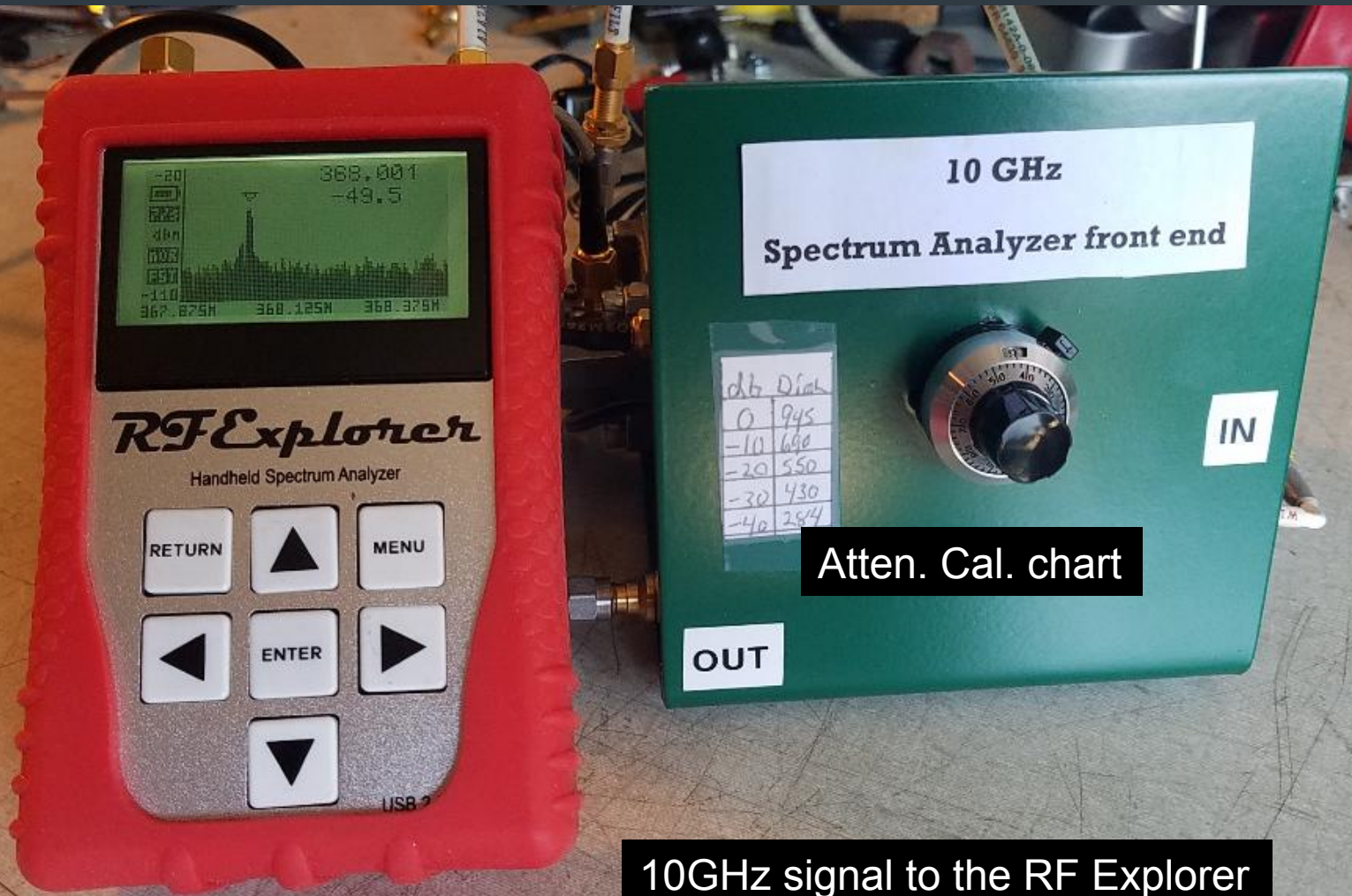
With fixed attenuators added, -30dbm input = -30dbm output

MS2712E at 368MHz with LNB on 10.368 GHz



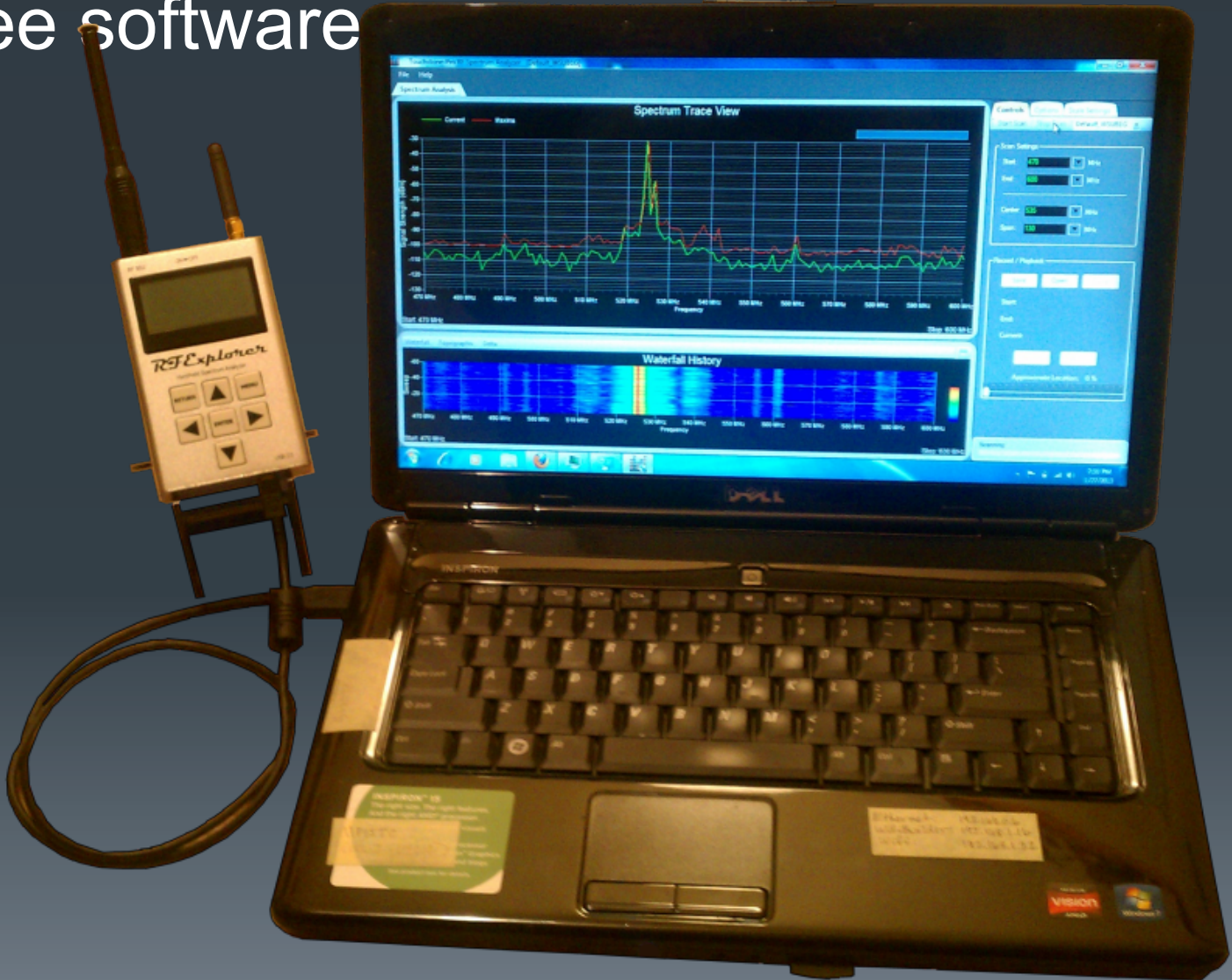
10GHz signal on the Anritsu MS2712E (368MHz)

RF Explorer as a 10GHz Spectrum Analyzer



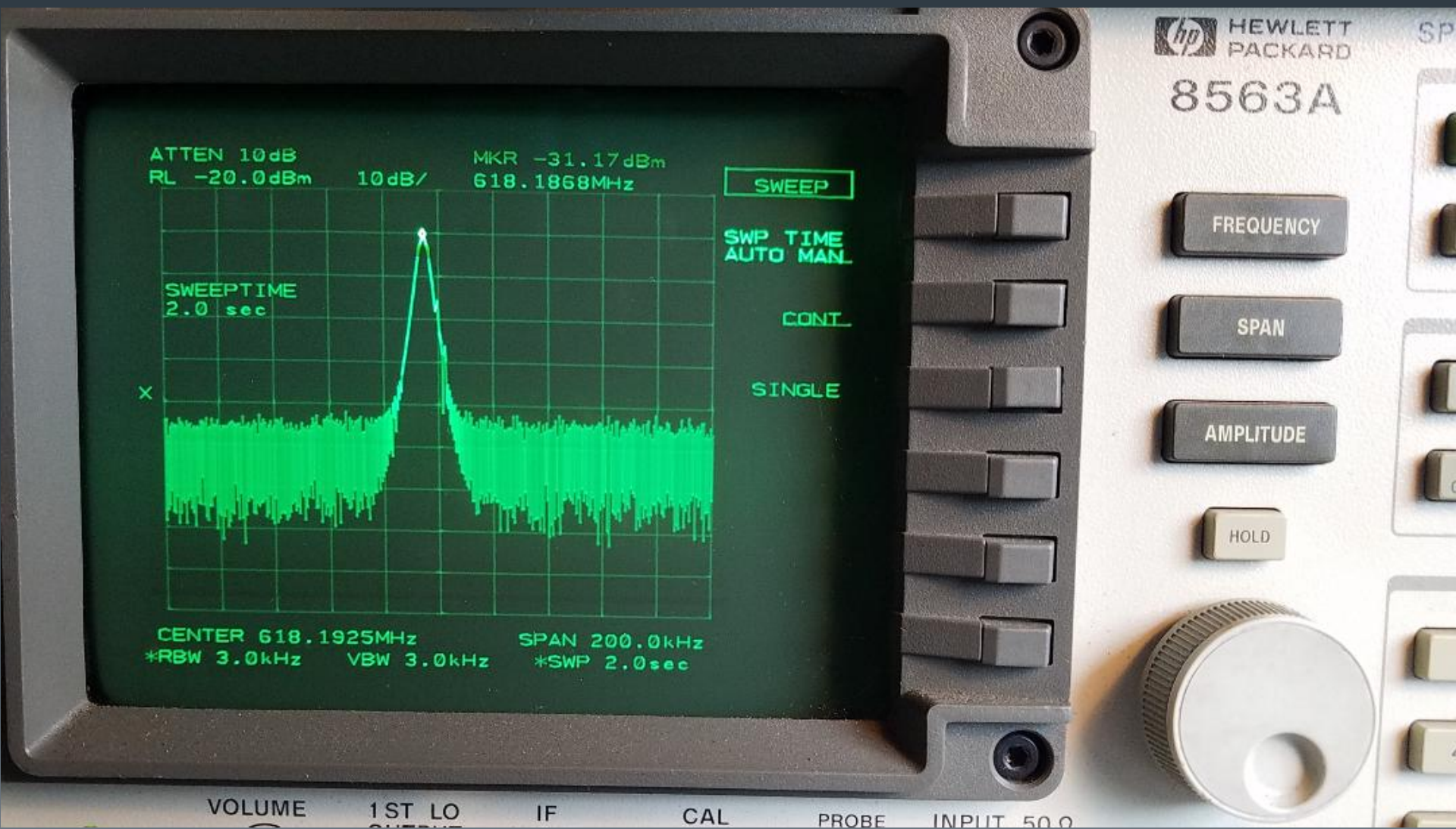
10GHz signal to the RF Explorer
-30dbm in = -30dbm output

RF Explorer in action.
Can be linked via USB to
Excellent free software

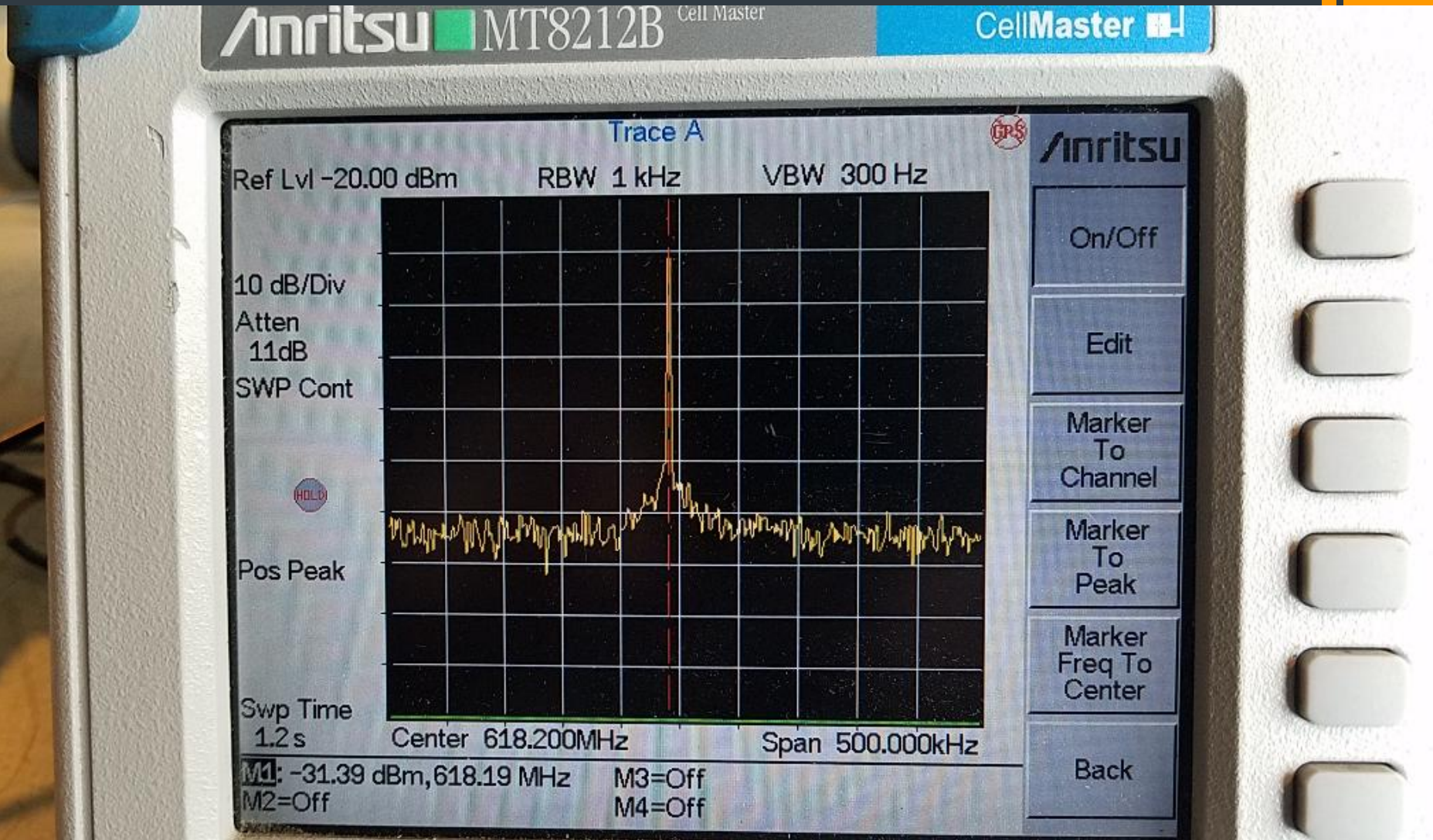


HP 8563A and similar

Live from L104



Live Signal from L104 LNB



Anritsu MT8212B \$700 and up


RF Explorer and 1320 LNB

10.368GHz in is
368.27MHz out.

\$200 total

10.368GHz input=
368.270MHZ output





Hand held
Battery operated
Spectrum Analyzers
for
Higher Bands.

24GHz Front End

24.5GHz signal

HP11970K mixer

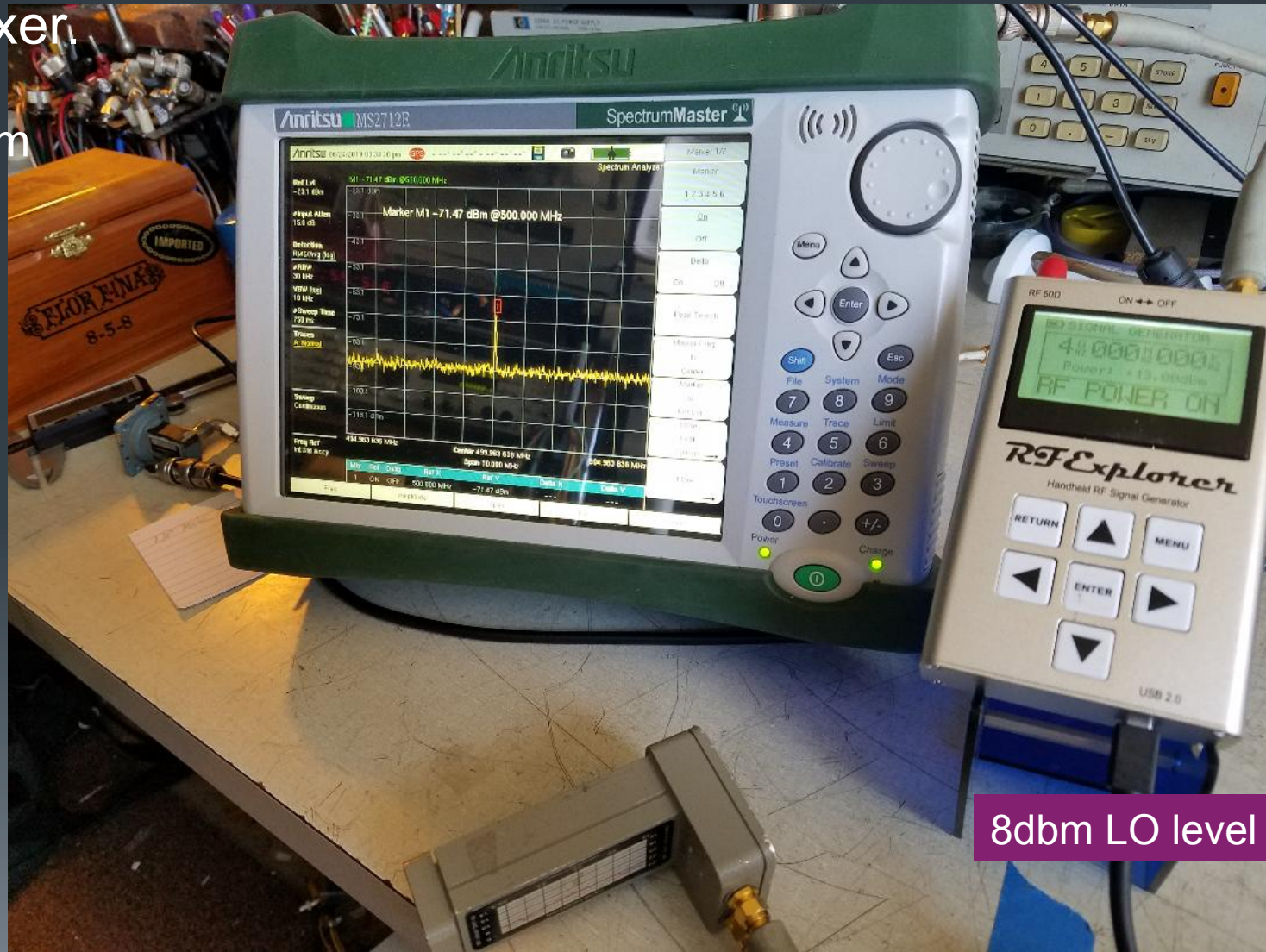
4GHz LO. @ 8dbm

500Mhz

Signal on the SA

-20db mixer loss.

Anritsu MS2712E



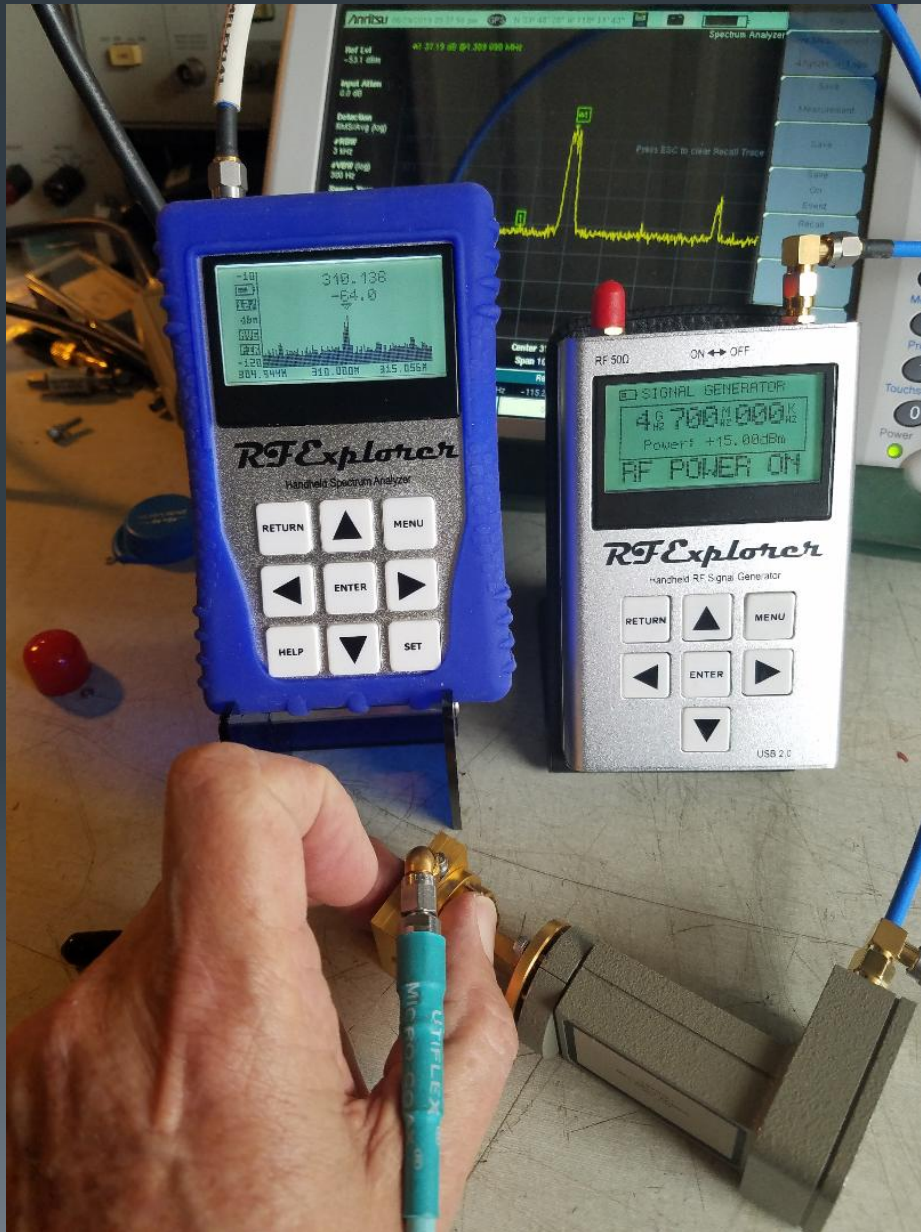
8dbm LO level

RF Explorer pair and Mixer at 24.5GHz

4GHz LO
500MHz IF

(less than \$500)





47GHz!

HP11970Q mixer

36mw drive from the RF Explorer Gen.
at 4.7GHz.

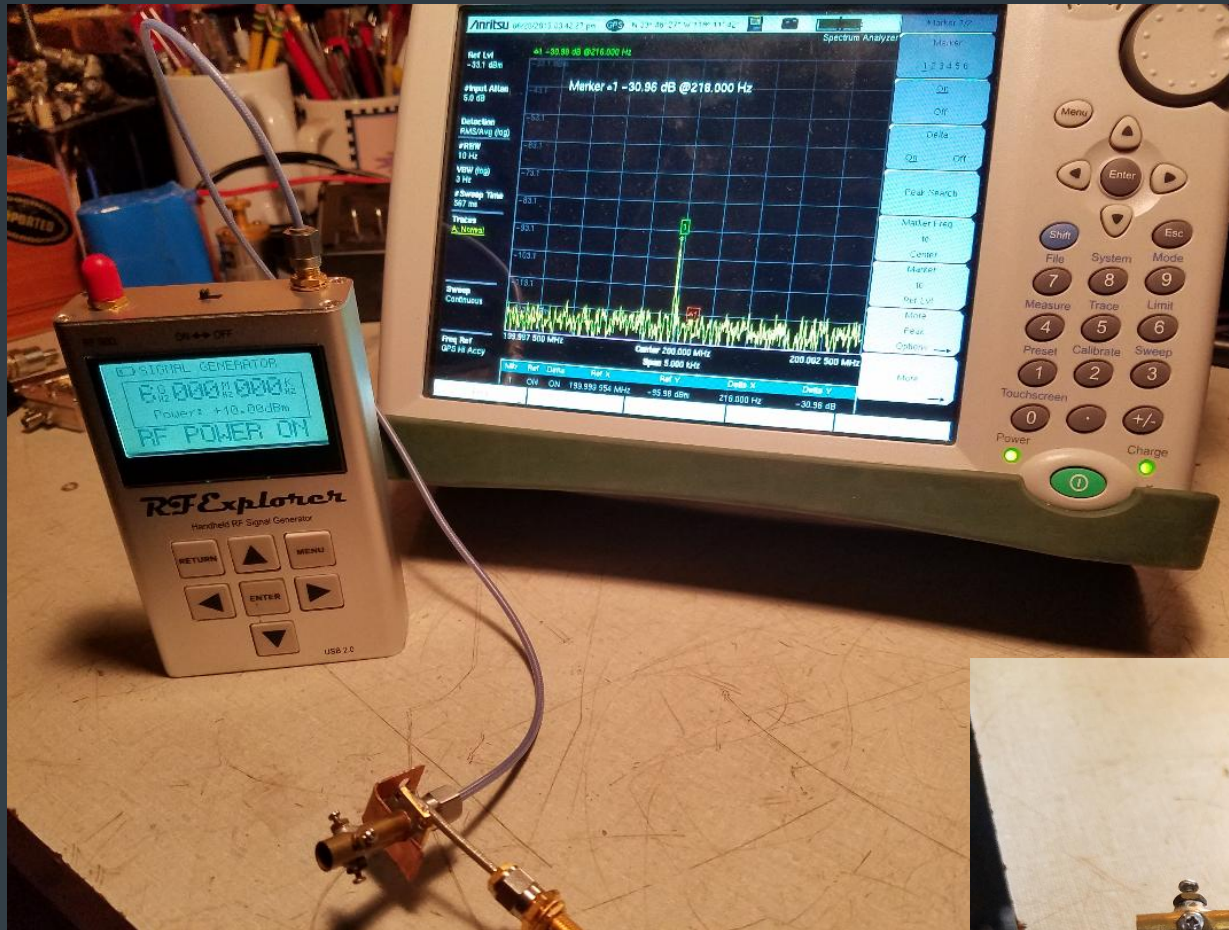
IF is 310MHz on RF Explorer SA

47GHz Sig Generator-

HP8673B

Spacek Doubler.

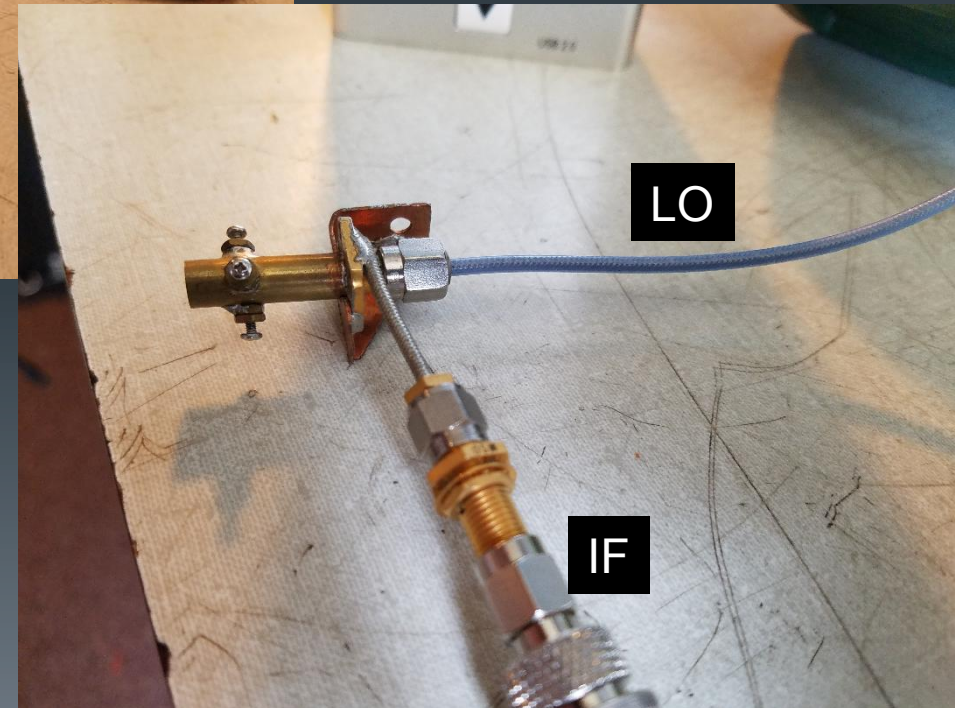
(Saved trace on the Anritsu in the
background from same
set up.)



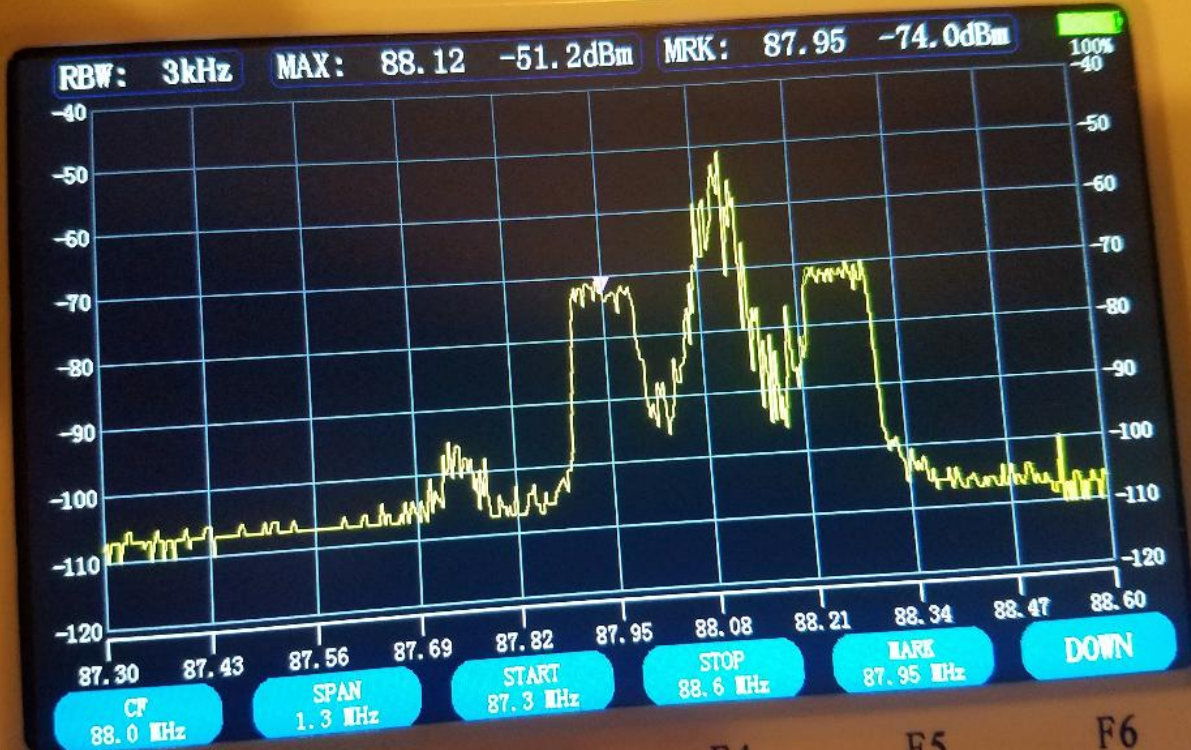
Inexpensive mixer

Brass tubing and a
Qualcomm diode

K6IZW home made mixer 24-79GHz
Shown on 24GHz with 6GHz LO.
(see ref.)



Late addition- 10 to 2700MHz Hand Held Analyzer



- 3KHz minimum selectivity
- Waterfall
- 9 hour battery
- 5" screen
- \$320



Extras

Bias Tee- Ebay \$15



To
Radio

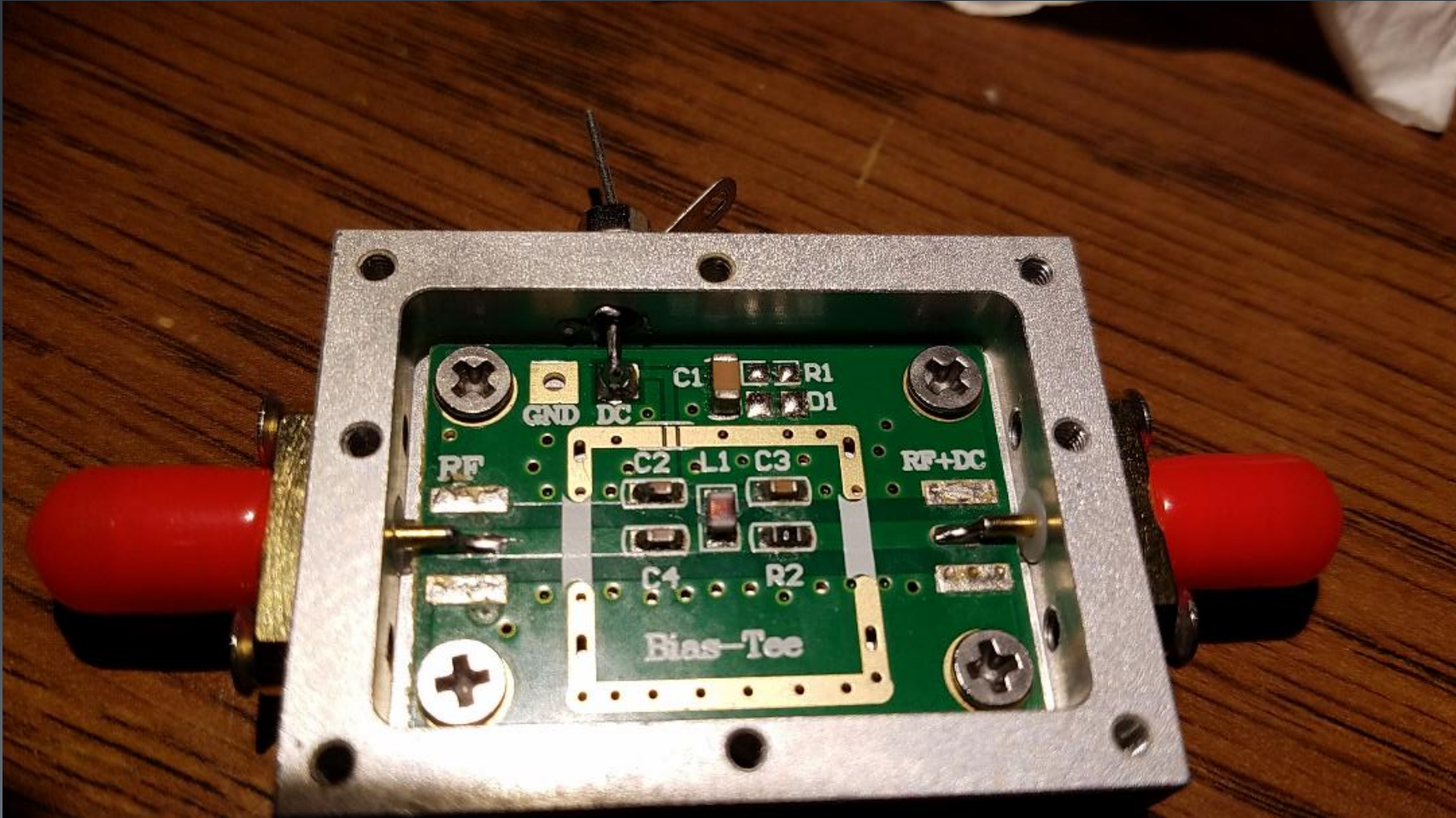
To
LNB



Buy a pile of .1uh chokes
And tape one to the lid.

Bias Tee Inside

15 bucks?



Portable 13.75" dish 27db gain



\$15

That's it- Thank You

- Many thanks to Rein W6SZ for his help as well as Helen KI6LQV.
- I'll run through the slides and take questions along the way.
- Feel free to contact me.

■ drzarkof56@yahoo.com



References

- Home made mixer from Kerry K6IZW
 - <http://www.ham-radio.com/sbms/sd/47ghzmxr2.pdf>
- K6JEY Talk on Mixer evaluation.
 - http://www.nitehawk.com/k6jey/harmonic_mixationers.pptx



Fin





LNB's have a variety of uses
and are easy to modify.
I hope this presentation
has been helpful.

GPS Source



- Hold over with no GPS!
- Tracks 20 satellites
- Tracks all positioning systems
- Excellent software sets output.
- -144db Phase noise at 1KHz
- Nice clean 14th harmonic at 10GHz

Avenger outside PLL and crystal based. Very sensitive



\$10

L104 and Alinco from the car

Everything on battery

Easily to receive the
Santiago
beacon.

Usable stability.



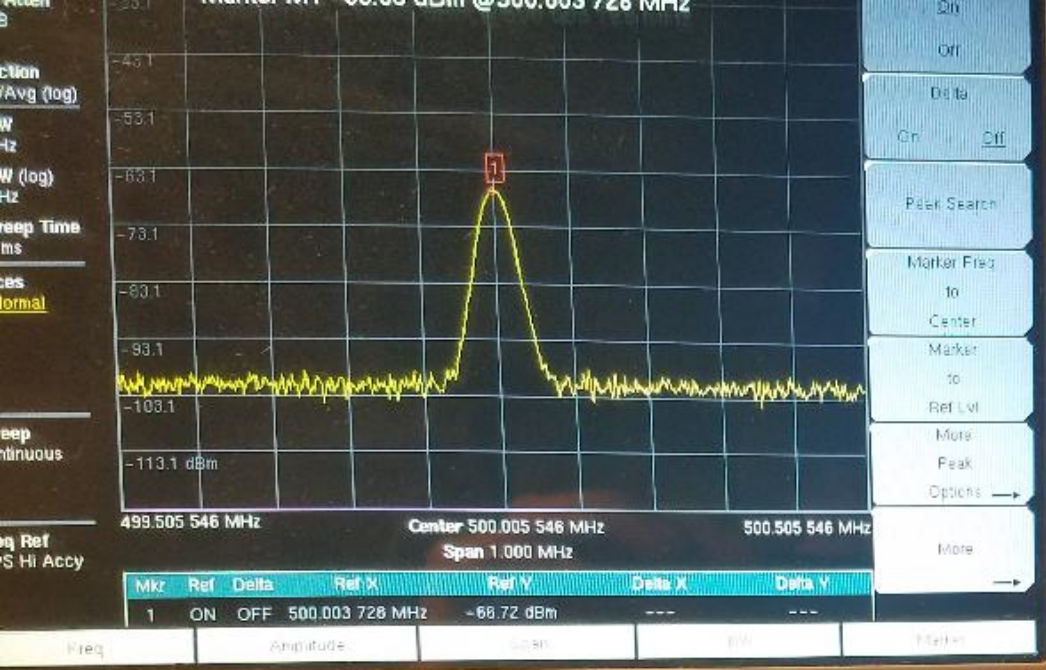
RSP 2 or Dongle SDR

- The better the dongle the better the results
- The RSP 2 will give good analysis results
- A dongle is the best low cost option.
- The least portable since you will need a computer.

General Ideas on Analyzers

- DO NOT buy–
- A great analyzer that doesn't work or mostly works.
- An older unit like a Systron Donner
 - unless it costs less than \$50
- An obscure unit unless the price is very right
- An incomplete unit- “it just needs a cable or YIG”
- ***What follows are some suggestions.***





On

Off

Delta

On Off

Peak Search

Marker Freq to Center

Marker to Ref Lvl

More Peak Options

More

Touchscreen

Power

RF 500 ON/OFF

SIGNAL GENERATOR

4.000000 MHz

Power: +10.00dBm

RF POWER ON

RF Explorer

Handheld RF Signal Generator

RETURN MENU

ENTER

USB 2.0



Results with Various LNBS and Spectrum Analyzers


Example ONE-
RF Explorer
Spectrum Analyzer



Live Signal from L104 LNB



RF Explorer



Example ONE- RF Explorer Spectrum Analyzer New Model

- The WSUB1G+ model is about **\$170**
- It will cover 15KHz to 960MHz
- Gives you frequency and signal level accurately.
- USB charging and data output to computer.

New Model WSub1G+ \$175



50KHz to 960MHz

2.6KC and 200kc
Selectivity- better resolution

Anritsu 06/25/2019 11:45:57 am



N 33° 48' 29" W 118° 11' 43"



Spectrum Analyzer

Ref Lvl
-3.1 dBm

#Input Atten
20.0 dB

Detection
RMS/Avg (log)

RBW
1 kHz

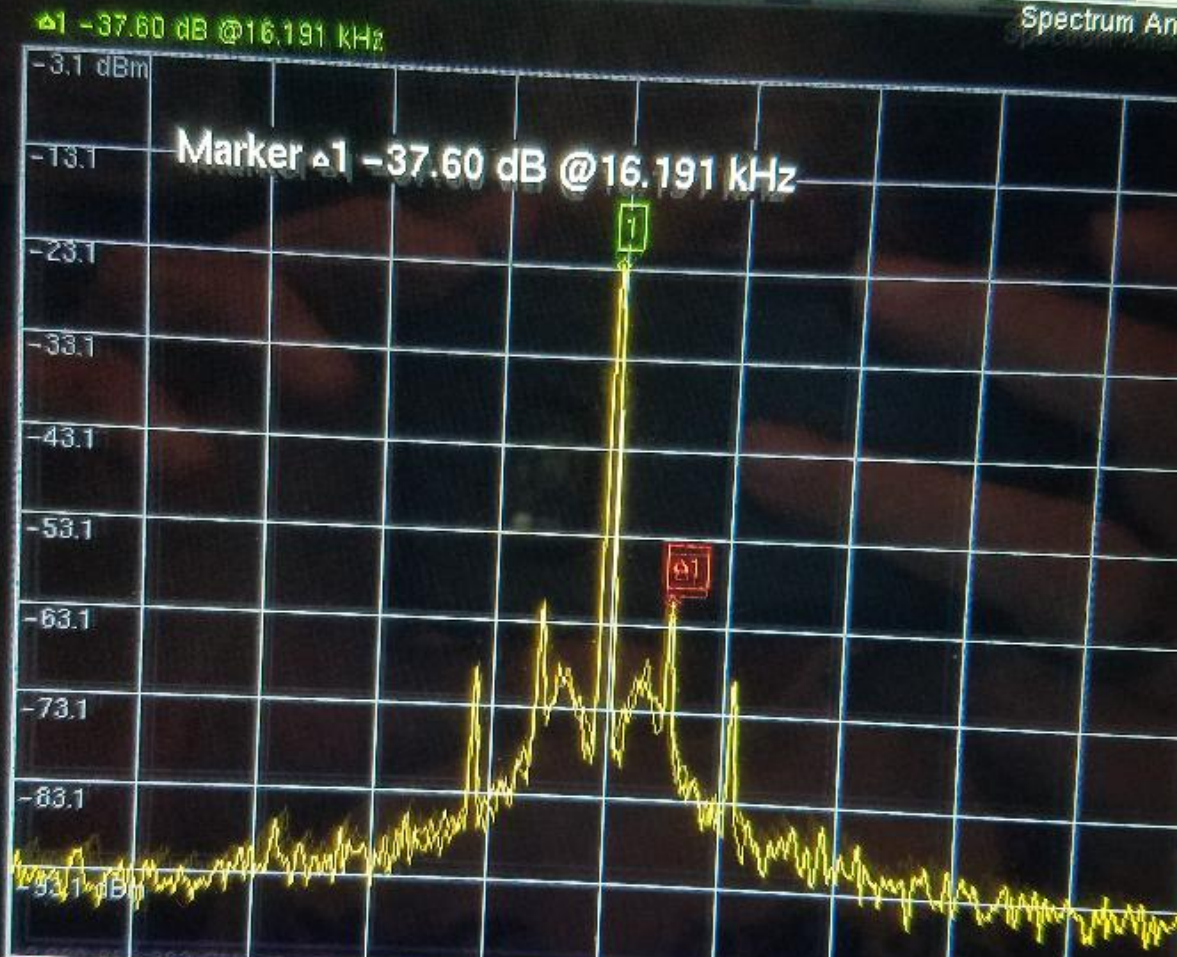
VBW (log)
300 Hz

#Sweep Time
567 ms

Traces
A: Normal

Sweep
Continuous

Freq Ref
GPS Hi Accy



3.899 856 363 GHz Center 3.900 GHz 3.900 143 636 GHz
Span 287.273 kHz

Mkr	Ref	Delta	Ref X	Ref Y	Delta X	Delta Y
1	ON	ON	3.899 996 955 GHz	-22.65 dBm	16.191 kHz	-38.55 dB

Marker 1/2

Marker

1 2 3 4 5 6

On

Off

Delta

On

Off

Peak Search

Marker Freq

to

Center

Marker

to

Ref Lvl

More

Peak

Options →

More



Freq

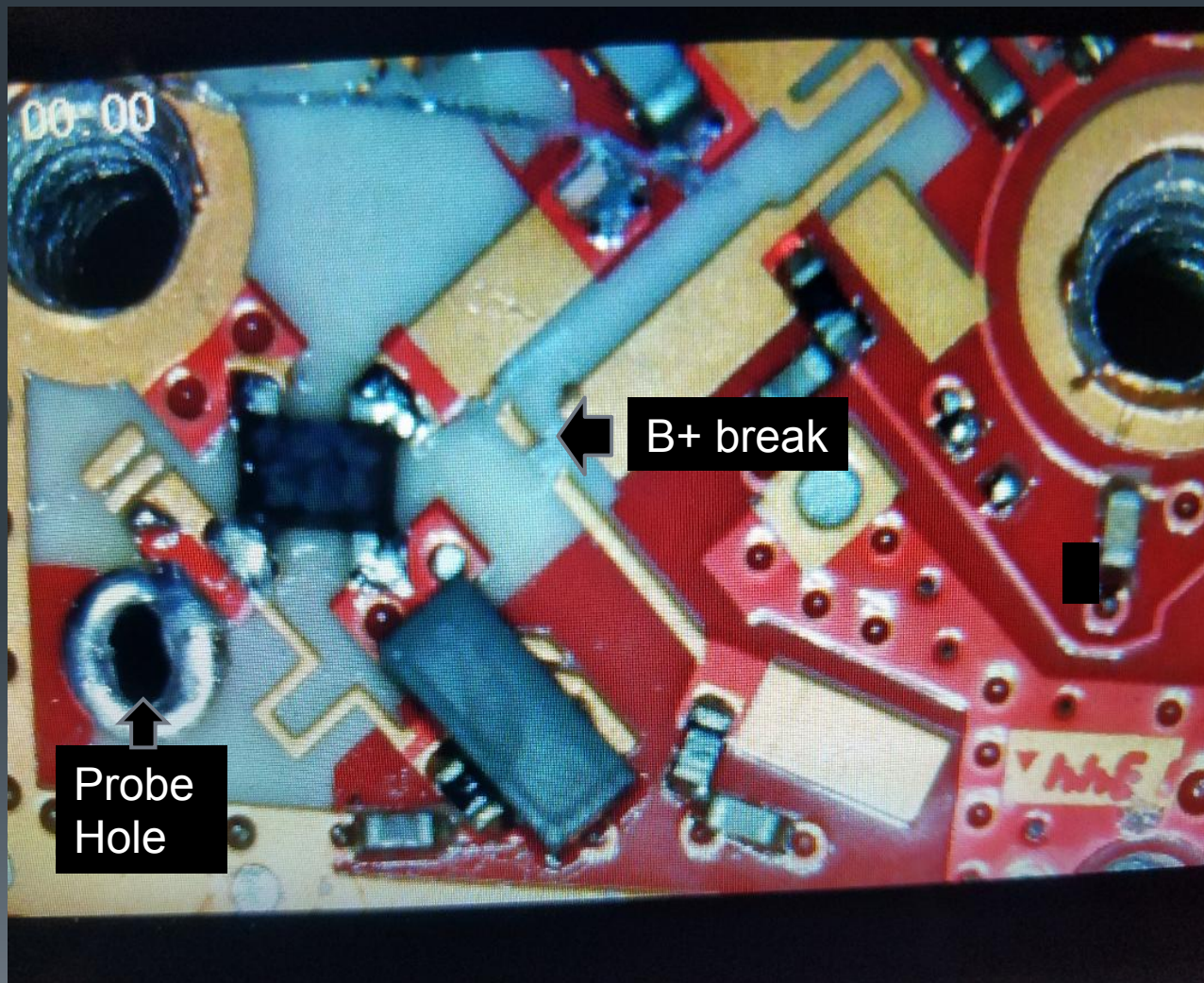
Amplitude

Span

BW

Marker

LNB Inside via microscope



**Internal
modifications
L104**



This Talk is About

- Choosing a good LNB
- Key modifications
- Back end receiver choices
- Spectrum analyzer uses
- Accessories
- Test results

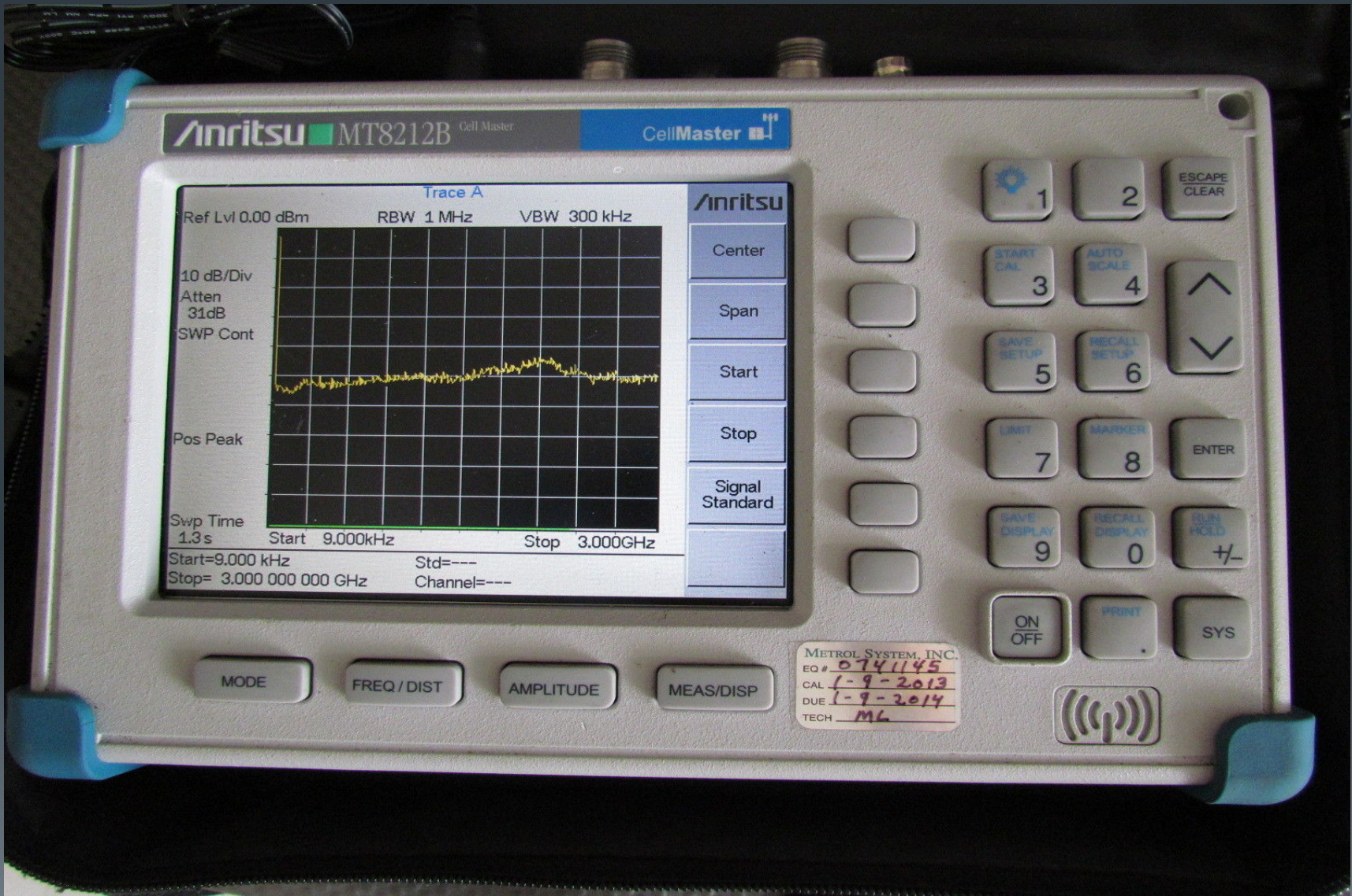
Close-in display of spurs at 24.5GHz



Conclusion

- For not much money you get-
- Great spectrum analyzer first mixer for 10GHz
- Good quality receiver for 10GHz
- How Much?
 - LNB \$10
 - Bias Tee \$15
 - Dongle \$25 = \$50

Anritsu MT8212B \$700 and up



Test Results- one minute after 5 minutes warm up.

